REMARKS

Claims 1-29 are in this application. Claims 14-21 have been withdrawn as being directed to non-elected species. Claims 1-13 and 22-29 are currently pending in this application.

Applicants gratefully acknowledge that the Office Action dated April 3, 2006 has rejoined claims 22-29 to the claims of elected species A for further examination on the merits.

Claim 1 is currently amended to recite a method of forming a patterned thin film "....wherein said self-assembled monolayer is formed from molecular species having a head functional group for interaction with said surface of said substrate and a tail group for chemical differentiation of patterned and unpatterned regions of said self-assembled monolayer without forming a covalent bond."

Thus, claim 1, as amended, reads:

> "1. (original) A method of forming a patterned thin film, wherein said thin film is not a monolayer, said process comprising the step of:
> depositing a thin film material on a surface of a substrate having thereon a patterned underlayer of a self-assembled monolayer having patterned and unpatterned regions;
> wherein said self-assembled monolayer is formed from molecular species having a head functional group for interaction with said surface of said substrate and a tail group for chemical differentiation of patterned and unpatterned regions of said self-assembled monolayer without forming a covalent bond."

Support for the amendment is found:

(1) on page14, line 18 to page 15, line 3, where the specification states:

"The deposition, formation, and properties of self-assembled monolayers (SAM) are active areas of scientific research. Monolayers of molecules are chosen with functional head groups that selectively bind to particular solid substrate surfaces and tail groups that pack and interact with their neighbors to form relatively ordered molecular monolayers.

Suitable molecular species that can form a self-assembled monolayer include organic molecular species having:

(1) a head functional group for interaction with the surface of the substrate forming a coated surface; and

(2) a tail group for chemical differentiation of the patterned and unpatterned regions of the coated surface."

(2) on page12, line 22 to page 13, line 10, the specification states:

"A thin film deposited by the method of the present invention is described in EXAMPLE 5. This film is not a monolayer.

The thin film in the present invention can be a material, for example, a polymer, a hybrid material, etc., which does not require a chemical reaction with the substrate surface to form a thin film. Thus, there is no covalent chemical bond formed between the thin film and the substrate. Typically, the thin film according to the present invention is physically adsorbed, not chemically bound, to the substrate (see, for example, EXAMPLE 5).

In contrast, a SAM, as described in the known methods of the prior art, requires a head group that chemically binds to the substrate surface to form a monolayer, which is chemically bound to the substrate to form a monolayer that is bound to the substrate to form a single material or chemical entity."

(3) on page 10, line 28 to page 11, line 2, the specification states:

"The self-assembled monolayer (SAM) according to the present invention comprises organic molecular species having functional head groups that bind to the particular solid substrate surface and tail groups that affect the wettability of the particular solution deposited thin films."

(5) on page 24, line 29 to page 25, line 23, the specification states:

"Fig. 3A illustrates the solution deposition technique known as spin-coating. Fig. 3B depicts substrate having thereon a patterned thin film after the substrate is spun.

Following the deposition and patterning of the self-assembled molecular monolayer, a solution containing the desired thin film material 60, or a precursor, is flooded across the entire substrate surface 64, pre-patterned with a self-assembled molecular monolayer 62. The tail group of the self-assembled molecular monolayer 62 is chosen to provide chemical differentiation, for example hydrophobicity versus hydrophilicity, between patterned 62 and unpatterned 66 regions of the solid substrate surface 64. The chemical differentiation across the substrate surface, between 62 and 66, affects the wettability of the solution deposited thin film so that upon spinning, the material deposits only in unpatterned regions 66, forming a patterned thin film 68 on the substrate surface 64. The thickness of the patterned thin film material 68 is controlled by choosing the concentration of the thin film material or its precursors in the solution 60 and the rate of revolution of the spinning substrate 64."

(5) on page 31, line 27 to page 32, line 20, the specification states:

"**EXAMPLE 5**

As silicon dioxide surface on an n-type silicon wafer was patterned by microcontact printing with a self-assembled monolayer of (tridecafluoro 1,1,2,2-tetrahydrooctyl)trichlorosilane. The chemically differentiated substrate surface was used to define the pattern of a thin film of 50 nm silica particles deposited from a colloidal suspension (Highlink OG 113-53), produced by Clariant Corp, which incorporates isopropanol and hexamethylene diacrylate as spin-casting solvents.

Silica particles and other high index particles can be used as photonic band gap materials to control the propagation and diffraction of light, and as lenses. Similarly, thin films of smaller nanocrystalline materials, which may be for example semiconducting, metallic, superconducting, ferroelectric, and magnetic, can be patterned.

These materials can be patterned for applications such as light-emitting diodes, thin film transistors, photovoltaic devices, ferroelectric memory applications and storage devices."

Thus, the self-assembled monolayer according to the present invention is formed from molecular species having (1) a head functional group for interaction with the surface of the substrate and (2) a tail group for chemical differentiation of patterned and unpatterned regions of the self-assembled monolayer **without forming a covalent bond**.

The above features of the instant claims easily distinguish the instantly claimed method of forming a patterned thin film from the methods known in the prior art in which SAM's require a **head group that chemically bonds to the substrate surface to form a monolayer** to form a single material or chemical entity. For example, in hexadecanethiol, the thiol functionality forms a chemical bond with a substrate, such as, gold.

Claims 1-4, 22-24, and 29 are rejected under 35 USC §102(b) as being anticipated by U.S. Patent No. 5,545,432 to DeGuire et al., herein after "DeGuire et al."

DeGuire et al. describes the use of a SAM to template the deposition of a metal oxide thin film from a precursor solution. This requires the tail (end sticking out into solution) to react with the precursor solution.

In the instant application, the SAM is not reactive toward the deposited thin film. The instant method does not involve forming a bond between the SAM and the deposited thin film. The SAM is used to differentiate the nature of the substrate surface to pattern a solution deposited thin film.

Depositing the film on the SAM according to the instant method does not proceed through the reaction of a precursor with the SAM. In contrast, the SAM in DeGuire et al., formation of the material through a reaction is essential. Some examples even require annealing to convert an intermediate film to the desired oxide.

In Column 3, lines 60 to 65, DeGuire et al. states:

> "Metal oxide-containing films, such as those containing Fe, Ti, Sn, Zn, Zr or other metal oxides, may be deposited onto organic layers consisting of self-assembled monolayer films (SAM), which have been functionalized with -OH, -COOH or -SO_3H groups. These may be referred to as terminal functional groups."

In Column 4, lines 65 to 67, DeGuire et al. states:

> "The underlying substrate to which the SAM bonds preferably includes an inorganic material such as silicon, glass, aluminum, titanium, nickel or other metal or alloy with a native or thermally-produced oxide coating. As seen in FIG. 1, the trichlorosilane functionality at a first end on the long-chain hydrocarbon reacts with the surface of the substrate and forms a strong covalent bond with oxygen present on the surface of the substrate. The second end of the SAM includes a functionality suited for reacting with a solution and forming a bond with the resulting metal oxide film."

It is clear from the above requirements that the SAM's described by DeGuire et al. are formed through a chemical reaction.

Thus, DeGuire et al. clearly teaches that:

(1) the "trichlorosilane functionality at a first end on the long-chain hydrocarbon reacts with the surface of the substrate and forms a strong covalent bond with oxygen present on the surface of the substrate;" and

(2) "The second end of the SAM includes a functionality suited for reacting with a solution and forming a bond with the resulting metal oxide film."

In contrast, instant claim 1, as amended, defines that the self-assembled monolayer according to the present invention is formed from molecular species which have:

(1) a head functional group for interaction with the surface of the substrate; and

(2) a tail group for chemical differentiation of patterned and unpatterned regions of the self-assembled monolayer **without forming a covalent bond**.

These features of the instant claims easily distinguish the instantly claimed method of forming a patterned thin film from the method of DeGuire et al. which require SAM's in which **the functional groups chemically bond to the substrate surface to form a monolayer** thereby forming a single material or chemical entity. For example, in hexadecanethiol, the thiol functionality forms a chemical bond with a substrate, such as, gold.

The self-assembled monolayer films (SAM) DeGuire et al. have been functionalized with -OH, -COOH or $-SO_3H$ groups, i.e., terminal functional groups, which chemically bond to the surface of the substrate to form covalent bonds (see, for example, Column 3, lines 60 to 65, and Column 4, lines 65 to 67, of DeGuire et al. quoted herein above).

Therefore, claims 1-4, 22-24, and 29 are not anticipated by DeGuire et al. Accordingly, the rejection of claims 1-4, 22-24, and 29 under 35 USC §102(b) as being anticipated by DeGuire et al. should be withdrawn and claims 1-4, 22-24, and 29, and claims depending directly or indirectly therefrom, should be allowed.

Claims 5-11 are rejected under 35 USC §103(a) as being unpatentable over DeGuire et al. in view of U.S. Patent No. 5,512,131 to Kumar et al. (herein after Kumar et al.).

It was shown herein above that the SAM's described by DeGuire et al. are formed through a chemical reaction. Thus, DeGuire et al. teaches that (1) the

"trichlorosilane functionality at a first end on the long-chain hydrocarbon reacts with the surface of the substrate and forms a strong covalent bond with oxygen present on the surface of the substrate;" and that (2) "The second end of the SAM includes a functionality suited for reacting with a solution and forming a bond with the resulting metal oxide film."

In contrast, instant claim 1, as amended, and claims 5-11 which depend directly or indirectly therefrom, define that the self-assembled monolayer according to the present invention is formed from molecular species which have (1) a head functional group for interaction with the surface of the substrate; and (2) a tail group for chemical differentiation of patterned and unpatterned regions of the self-assembled monolayer **without forming a covalent bond**. Thus, DeGuire et al. does not teach or suggest these features of the instant claims.

Kumar et al. teaches the use of a stamp to deposit a SAM on a substrate. However, it also does not teach or suggest the features of the instant claims described above. Accordingly, the combination of DeGuire et al. and Kumar et al. still does not teach or suggest all of the features of the instant claims.

Since the cited art, either alone or in combination, must teach or suggest all of the claim limitations, in this case one of the basic requirements for a proper *prima facie* case of obviousness has not been met. See In re Vaeck, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991).

Therefore, claims 5-11 are not obvious over DeGuire et al. in view of Kumar et al. Accordingly, the rejection of claims 5-11 under 35 USC §103(a) as being obvious over

DeGuire et al. in view of Kumar et al. should be withdrawn and claims 5-11 should be allowed.

Various claims are rejected under 35 USC §103(a) as being unpatentable over (1) DeGuire et al. in view of Kumar et al. and further in view of U.S. Patent No. 5,688,642 to Chrisey et al., herein after "Chrisey et al." or (2) DeGuire et al. in view of Kumar et al. and further in view of U.S. Patent No. 5,059,258 to Wefers et al., herein after "Wefers et al." or (3) DeGuire et al. in view of U.S. Patent No. 6,423,465 to Hawker et al., herein after "Hawker et al." or (4) DeGuire et al. in view of U.S. Patent No. 5,115,336 to Schilkraut et al., herein after "Schilkraut et al." (see the Office Action for additional details).

In the above rejections, DeGuire et al. is the common reference. However, as shown herein above, DeGuire et al. is deficient in teaching or suggesting the features of instant claim 1, as amended, and the claims depend directly or indirectly therefrom.

Claim 1, and the claims depending directly or indirectly therefrom, define that the self-assembled monolayer according to the present invention is formed from molecular species which have (1) a head functional group for interaction with the surface of the substrate; and (2) a tail group for chemical differentiation of patterned and unpatterned regions of the self-assembled monolayer **without forming a covalent bond**.

Clearly, DeGuire et al. does not teach or suggest these features of the instant claims.

None of Kumar et al., Chrisey et al., Wefers et al., Hawker et al. and Schilkraut et al., either alone, or in combination with any of the remaining references teaches or

suggests the above described features of the instant claims. Therefore, the combination of DeGuire et al. with any two of the remaining references still does not teach or suggest the above described features of the instant claims let alone teach or suggest all of the features of the instant claims.

Since the cited art, either alone or in combination, must teach or suggest all of the claim limitations, in this case one of the basic requirements for a proper *prima facie* case of obviousness has not been met. See In re Vaeck, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991).

Therefore, the rejection of the claims under 35 USC §103(a) as being unpatentable over (1) DeGuire et al. in view of Kumar et al. and further in view of Chrisey et al. or (2) DeGuire et al. in view of Kumar et al. and further in view of Wefers et al., or (3) DeGuire et al. in view of Hawker et al., or (4) DeGuire et al. in view Schilkraut et al., should be withdrawn and the rejected claims should be allowed.

Applicants had provisionally elected Species A (Self-assembled monolayer is prepared by a stamp) for further prosecution. Accordingly, claims 14-21, directed to non-elected Species B (Self-assembled monolayer is prepared by exposing the self-assembled monolayer to radiation with a mask), had been withdrawn.

The Office Action dated October 19, 2005 stated that claims 1-4 are generic to Species A and Species B. Applicants agreed that claims 1-4 were generic. However, Applicants pointed out that claims 22-29 are directed to the thin film in claim 1 being deposited by a solution-based deposition process and they read on Species A and Species B. Thus, claims 22-29 should also be examined along with claims 1-4, in as much as they relate to Species A. Claims 22-29 are now rejoined.

Applicants believe that claim 1, which is generic to Species A and B, is allowable. Applicants respectfully point out that if an independent claim is unobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Further, in accordance with linking claim practice, if the claims of a non-elected species (Species B, directed to self-assembled monolayer being prepared by exposing the self-assembled monolayer to radiation with a mask) is free of prior art, the non-elected species must also be rejoined and allowed.

Therefore, Applicants respectfully request reconsideration of this application, rejoining of withdrawn claims 14-21 and allowance of all currently pending claims.

Accordingly, an early indication of the allowability of claims 1-29 by issuance of a Notice of Allowability is earnestly solicited.

Respectfully submitted,

Date: August 2, 2006 By: V. Alexanian

Vazken A. Alexanian
Agent for Applicant(s)
Registration No. 37,270
Ohlandt, Greeley, Ruggiero
& Perle, L.L.P.
One Landmark Square, 10th Floor
Stamford CT 06901-2682
Tel: 203-327-4500
Fax: 203-327-6401